ACCOMPLISHMENTS

of the

ALLEGHENY FOREST EXPERIMENT STATION

1927 - 1940

Maintained by the United States Department of Agriculture,
Forest Service and Bureau of Plant Industry, at Philadelphia, Pennsylvania.
In cooperation with the University of Pennsylvania.

R - AL
REPORTS
Station

September 16, 1940

Accomplishments of the Allegheny Forest Experiment Station

1927 - 1940

Annually, the Forest Experiment Stations review their accomplishments for the past year and prepare plans for the next year based on past work and current needs. From time to time it is desirable to review in detail the accomplishments for the past several years, and to reappraise them as a foundation structure upon which future research may safely be built. Such review is particularly timely today when every public expenditure for non-military purposes is being critically scrutinized, and yet when all thoughtful people realize that permanent defense must rest upon attainment and maintenance of a high state of productivity for industry and renewable resources alike.

Broadly stated, the accomplishments of the Allegheny Station from its establishment in 1927 to date may be summarized as follows:

1. We have established certain facts, or workable theories, concerning forest management, forest influences, and forest economics in the states of Delaware, Maryland, New Jersey, and Pennsylvania. Many of these facts we have published, and all are intended for eventual publication.

2. We have developed specialists who, if called upon, can make effective use of the above facts in any given circumstances.

3. We have laid a substantial basis for the accumulation of additional facts and for the further development of our specialists.

4. We have built up, among local foresters and forest land owners, a livelier faith in the value of research as applied to specific situations, thereby stimulating their demand for facts not only from us but from their own research organizations.

The facts referred to under paragraph 1, above, have been detailed in the Station's 130-odd publications (of which we attach an annotated list) and in our annual reports. They are given in brief in the following pages. Few of them are revolutionary, and few are wholly new. It would be difficult indeed to separate the information which

was available in the Allegheny territory prior to the Station's establishment from the facts which have been developed since. In many instances, we have done no more than arrange in orderly fashion, for readier use, information or hypotheses already available. Our major contribution has often been a substitution of specific information for shrewd surmise. This is directly in line with a statement made by Dr. Lars G. Romell, then Professor of Forest Soils at Cornell University, when he told an early meeting of the Advisory Council what research had done for European forestry. Research, Dr. Romell stated, had not revolutionized forestry practice in Europe, but had systematized it and placed it on an orderly basis of known fact. By no means have all of the new facts been developed independently by the Station. The administrative organization of the Forest Service (Region 7), the Forest Research Institute of the Pennsylvania Department of Forests and Waters, the less formal research units of the other State forestry departments, the agricultural experiment stations, the botany departments of some of the territory's numerous universities, and even foresters in private employ, have added very materially to the common stock of information.

In this condensed review of our own accomplishments it is not possible always to separate the Station's contribution from that of cooperating institutions and individuals. These have often aided by suggesting projects and methods of attack, by making available facilities for research, by furnishing data from their own research work, by participating directly in the research of the Station, and by contributing funds for cooperative projects.

FOREST MANAGEMENT

The greater part of the funds available to the Allegheny Station have been for investigations in the field of Forest Management; indeed, for the first ten years of its existence the Station had no money for any other field of research. Included in this field are silvics and silviculture, and the protection of forests against fire and climatic injuries. (Protection of the forest against disease, insects, and other living foes is not included.)

Silvics and silviculture of Allegheny hardwoods-hemlock

This forest type covers about 1/4 of the forest land of the Station's territory, chiefly on the Allegheny Plateau of western Pennsylvania and Maryland. In it was centered, after the Civil War, the great Pennsylvania lumber industry, and it still produces significant quantities of lumber. It supplies most of Pennsylvania's pulpwood, and all of its so-called chemical wood. The type is highly important for outdoor recreation - hunting, fishing, camping, and winter sports - and for watershed protection, covering as it does the headwaters of the Ohio, Susquehanna, and Delaware Rivers. The one National Forest in the Station's territory, managed primarily for saw timber production, is located here.

We have pioneered in an ecological approach to the many problems of this type. Our investigations have differentiated the main sub-types of the Allegheny hardwood-hemlock forest, and have established their probable successional relationships. A fact of immediate silvicultural significance is the finding that on the prevailingly heavy Plateau soils the enormously valuable white pine was not a permanent component of the virgin hardwood-hemlock forest, but maintained itself as a result of local catastrophes, which created conditions favorable to its reproduction and rapid early growth. Its common associates were the oaks (also formerly the chestnut) of the more southerly oak type. White pine on unglaciated soils is almost invariably succeeded by hemlock and northern hardwoods, which gradually invade the aging stands. Sugar maple, yellow birch, and beech are the characteristic elements of the Allegheny hardwoods-hemlock forest on north and east slopes and plateaus, while black birch and red maple are common on the south and west slopes. In the absence of fire, hemlock becomes an important part of the stand nearly everywhere. The valuable and fast-growing black cherry, like white pine, thrives in openings caused by fire, windthrow, or clear cutting, and in its temporary invasion of the northern forest is often accompanied by yellow poplar, ash, and cucumber magnolia. The requirements or preferences of the principal species for light, moisture, certain temperatures, and other environmental conditions, have been fairly satisfactorily defined, and their normal growth habits described. Unfavorable factors of the environment, which include diseases, glaze storms, protracted droughts, the grazing, browsing, and gnawing of animals, have been partially evaluated. The reproductive habits of the principal species, with the exception of hemlock, we now understand fairly well. Vegetative reproduction, as well as reproduction from seed, has been studied.

The fundamental information above described has been synthesized into recommendations for applied silviculture. The extreme importance of advance reproduction in perpetuating many species, and the difficulty of obtaining by timber stand improvement a satisfactory regeneration of young stands that have been clear-cut, have been conclusively shown. Repeatedly-coppiced stands degenerate, and the black cherry which comprises the bulk of some extremely fine second growth may make the third growth practically valueless. The possibility, under some circumstances, of removing the mature trees of the Allegheny hardwoods-hemlock type in two or more cuts, and of maintaining thereby high growth rates in the reserved trees, has been somewhat explored.

The time and method for improving young stands of northern hardwoods, by weeding and thinning, and the limitations of such work, have been experimentally demonstrated.

A manuscript assembling all of the information obtained to date in Allegheny hardwoods-hemlock has been finished in rough draft, and we believe constitutes as complete a picture as is available for any important forest type in the northeastern United States. The difficulty

of describing a forest type composed of a dozen important species, and of prescribing for it a system of silvicultural management, can hardly be over-emphasized.

Great acreages originally occupied by valuable species have been invaded after over-cutting and fire by aspen and fire cherry, very inferior species, particularly as producers of cellulose. The results attained by planting such areas have been studied extensively, and the adaptability of certain species to the commoner sites has been established. Improved methods of planting have been devised. Plantations have been made to determine which localities over the wide range of red pine, our most widely-used species for artificial forestation, produce seed stock best adapted to the Allegheny Plateau.

Protection, silvics, and silviculture of oak-pine in New Jersey

The oak-pine type, which extends from Cape Cod southward into the Gulf States, has three distinct provinces in the relatively small territory of the Allegheny Station. Nearly one and a half million acres of oak-pine forest in southern New Jersey are distinct from other portions of the type in forest composition, land use, and forest treatment. The greater acreage is dominated by pitch pine and chestnut oak, although there are more valuable species on some sites. Repeatedly clear-cut on short rotations, the South Jersey forests have suffered also from severe burning; 46,000 acres burned over in a single recent fire. Their situation within 75 miles of enormous metropolitan populations of New York and Philadelphia makes them potentially, as they are in part actually, extremely important centers of recreation. They cover, more or less adequately, watersheds of literally vital importance to the thronging recreational resorts of the Atlantic Coast.

Working in closest cooperation with the New Jersey authorities, the Station has analyzed the operation during recent years of the State system of fire control, and has tested one of the major aids to preparedness - the so-called fire danger meter. Improvement of the danger meter has involved basic studies of fuels, and the effect upon them of weather conditions. We have contributed substantially to a much-improved classification of major fuel types, and to the standardization of methods of appraising fire damage. Partly as a result of our studies, the State has greatly increased its use of water in fire fighting. We have contributed to a forthcoming State bulletin on forest fires, for the use of fire wardens and information of the general public.

Very closely related to some of the studies just described have been investigations of the possibility of using fire to increase the reproduction of pine. For the first time in the long history of forest fires in southern New Jersey, an accurate record is being kept of the effects of annual and periodic fires on the native vegetation of a sample area. Fires are set under careful control to determine whether burning can reduce competing vegetation or produce favorable seed-beds for pine.

This work was undertaken at the urgent request of the State Forester, and has been carried on as a joint enterprise. Another recent study not yet productive of conclusive information covers modification of the seed-bed by mechanical means. Preliminary results obtained by the Station from the use of hand labor has lead to a joint test of machinery.

The difficult problem of increasing seedling reproduction of valuable tree species on poor, sandy sites deteriorated by coppicing and fire over a long period of time has been the subject of Station research of a rather fundamental nature. Like most fundamental research, some of this work has no immediate application. The greater part of it has been done with chestnut oak. It has uncovered many reasons for the marked scarcity of oak seedlings in the south Jersey woods, without as yet suggesting practicable means of increasing their numbers.

Seed production, although variable from year to year, is apparently adequate, but the seed is very completely destroyed by animals and birds. In the absence of a mulch of leaves or other material, newly germinated seedlings fail to get their radicles into the soil, and germination is highest where the acorns are covered with soil to a moderate depth. The universal acidity of South Jersey soils is no bar to seedling reproduction of oaks, but abundant light is plainly necessary. Root competition from parent trees is less serious than that from lesser vegetation. Root rots, and injury above ground during the dormant season by climatic or biotic agencies, beset the seedlings, many of which reach a greater height during their first season than at any subsequent period.

Considerable information, in the aggregate, has been obtained about sprouting. This phenomenon, in spite of its importance in millions of acres of hardwood forest in the East, has been little studied. Reduced appropriations at the time the work was getting under way confined a comprehensive investigation of the root behavior of coppiced oak to a case-study of two trees. Sandiness of the south Jersey soils greatly facilitates excavation of roots, and we believe we have more complete knowledge of the roots of these two chestnut oak saplings, one undisturbed, and the other cut back and sprouting, than of any other sizable trees in American botany or forestry. An equally painstaking study, by somewhat different methods, has traced the root development of pitch pine of varying age from seedlings to maturity and has yielded other fundamental information of significance. Information of practical value in thinning of sprout clumps is being obtained from studies still under way.

Some information has been obtained on the relative value of six different species of pine, some native, others introduced, when planted in openings of typically under-stocked oak stands. For years interplanting has been extensively practiced in the State Forests of South Jersey, following clear-cutting of the oak.

Silviculture of loblolly pine on the Eastern Shore of Maryland

Some of the oldest sample-plot data in the Forest Service have been the basis for a thorough analysis of the effect of stand density and age on the diameter distribution of loblolly pine in even-aged stands. Nearly 73 sample plots were established in 1906 on private land in Worcester County, Maryland, and have since been remeasured at 5-year intervals. The effect of variation in stocking, artificially produced in the case of some plots, has been traced over a period of 30 years, and unique information has been obtained on natural mortality, which is a common source of error in growth predictions. Knowledge of the number of trees of specified diameters which occur in stands of a given age, or which may be expected in future stands of which the present distribution and age is known, is of particular value for a species like loblolly pine, which is salable in a wide range of diameters. In the hands of a local forester well informed on stumpage prices for different products, our findings permit of trustworthy advice on the relative profitableness of clear-cutting a pine stand today for pulp wood, or holding it for the production of lumber and piling, or partial cutting, which yields some immediate revenue without sacrificing large future returns.

Studies of volume, growth, and yield

No information which research may obtain has more practical, every-day use among foresters than data on the volume of wood in individual trees of various dimensions, and on the growth and yield at a given age, of forest stands. Scarcely less useful is knowledge of the distribution of wood volume between the large number of trees comprising a stand. This information is conveniently presented in tables, or even more compactly, in alinement charts.

The Alleghany Station has been a major participant in a comprehensive mensurational study covering the oaks of the entire eastern United States. This study began at the Appalachian Station, was continued at the Central States Station, and was completed by us. We not only contributed substantially to the basic data and put the whole in shape for publication, but also went a step farther than most studies of this kind by indicating the variation from the normal yields which results from understocking of stands.

Supplementing this major study, we have investigated tree volumes of a considerable variety of local species which are used in the round for mine timbers, and have expressed them in terms of such material.

This investigation was made cooperatively with the Pennsylvania State College, which published the results.

In another cooperative study, this time with Region 7, we established that the cubic contents of a stacked cord of chemical wood is not appreciably affected by the size of the trees from which obtained, provided the smaller sticks are not unduly crooked, and the larger sticks are split before stacking.

Local volume tables for all of the common species in the anthracite region of Pennsylvania have recently been prepared for use in the forest inventory of that Region. A list of all volume tables prepared by the Station follows the list of publications, attached.

For the use of the administrative organization of the Forest Service, in the Eastern Region (Region 7), the Station has recently completed a study of current rate of growth of the more important species of the Eastern Shore of Maryland both pine and hardwoods, when occurring in stands of average density for the Region. From information thus obtained, it is possible to predict the yield, 10 or 20 years hence, of present-day stands. Our data on mortality, earlier mentioned, has proved invaluable in this connection.

Miscellaneous studies

The Station has accumulated a substantial body of information on subjects outside its major studies. Opportunities occasionally arise to obtain valuable facts which later will be almost unobtainable. In this category are the joint findings of the Station and the Pennsylvania State College on the effect of the 1930 drought, in the forests of central Pennsylvania. This record drought eliminated not only hemlock from many stands of softwoods mixed with hardwoods, but also much white pine and pitch pine. Losses were smaller among the oaks. An unexpected finding was the relatively higher loss among the larger individuals dominating a stand, than among the smaller, overtopped individuals. Although such droughts may not occur at all during the lifetime of a particular stand, they must be considered in any long-time plan for forest management. This is also true of glaze storms, a particularly destructive example of which was studied by the Station in 1936. We then learned that on the plateaus and ridge tops of the Allegheny hardwoods-hemlock type it is risky to thin immature stands heavily, or to allow such species as black cherry to overtop other elements in dense stands; and that the evergreen hemlock, contrary to what might be expected, is among the species most resistant to glaze damage.

A pruning study in white pine, made at the request of the Maryland Forest Service and with the help of the CCC, demonstrated rather conclusively the superiority of certain tools and a relatively new method of pruning. Conclusions tentatively reached in a simultaneous study of thinning methods were immediately applied to some adjacent pine plantations.

Successful forest management in any region is contingent on a working knowledge of regional climate, and of local modifications of it, conveniently described as micro-climate. The Station early compiled from State reports, sometimes conflicting, maps of its territory showing annual precipitation, annual and seasonal temperatures, and length of growing season. Weather stations, some in the open and others in the forest, were operated for several years at our two older branch stations,

and revealed highly significant modifications of the regional climate produced by the forest itself. These modifications particularly affect natural reproduction, because newly-germinated seedlings are extremely sensitive to extremes of temperature and precipitation. The value of our meteorological observations is illustrated by our discovery in the course of the Flood Control Surveys that almost the only run-off records for small forested watersheds in the northeast are those we have obtained in the Kane Experimental Forest.

FOREST PATHOLOGY

For ten years since July 1, 1930, the Office of Forest Pathology, Bureau of Plant Industry, maintained a small staff in Philadelphia, in the closest cooperation with the Forest Service, and the University of Pennsylvania. Realizing the very great importance of a concerted attack on all aspects of the forest problem in its territory, we helped to establish this cooperation and have keenly regretted its recent discontinuance. From the time it forms as seed on the parent tree, to the day of its death several centuries later, every species of tree in our territory is exposed to more or less serious disease. Without an understanding of the more important of these diseases the forest manager cannot succeed.

The three major pathological projects worked on at Philadelphia have been the diseases of nursery stock, the heart rot of sprout hardwoods, and mycorrhizae.

Tree planting has bulked very large in the progress of forestry in the Allegheny territory and has been done on 230,000 acres. Nearly all of the planting stock has been produced locally. Since 1930 nearly every public nursery has appealed to us for help in solving some critical problem resulting from damping-off disease, root rot, or unbalanced soil conditions. Entire plantings of certain species, or whole sections of hitherto productive nurseries, have been threatened, and extremely valuable assistance has been promptly given by the Station pathologist. The great variety of nursery soils, and the multiplicity of species planted, have made generalized remedies valueless, and in some cases several months' investigation by highly trained technicians has been necessary for successful diagnosis of specific troubles and their satisfactory cure. Our pathologists have not been content to offer stop-gap remedies, but have studied the effect, over long periods, of the treatments prescribed.

Soil reaction (acidity or alkalinity) being of critical importance in control of pathogens, a method has been developed of determining what chemicals, and in what quantity, must be applied to bring any given soil to a desirable condition. Knowledge in this field has proved a positive embarrassment to the Station, having lead to submission of soil samples by nurseries all over the United States, with queries as to proper treatment against damping-off and root rots.

A very high percentage of the hardwood timber of the Allegheny territory, particularly the oaks, is of sprout origin. Excellent local markets for small-sized material, such as exist in the anthracite and other coal fields of the territory, have encouraged the cutting of timber while still young. Succeeding forest crops are necessarily largely sprouts. Much of the timber stand improvement done by the CCC and other emergency organizations has involved the thinning of sprout clumps, a practice which our pathologists found under some circumstances to result in the spread of serious heart rots in the remaining stems. Much depends on the species, the age of the clump, and the height at which the surplus stems are cut. A very practical and helpful bulletin on this subject has been published by pathologists who did considerable field work in the territory of the Allegheny Station and office work at Philadelphia.

One or more species of soil-inhabiting fungi have been found in habitual association with the roots of practically every species of tree and woody plant in the Allegheny territory. This association is called "mycorrhiza". Mycorrhizal roots have few, if any, root hairs, and the higher plant must absorb soil moisture and solutes through the curious club-shaped appendages formed by fungi on their roots. Whether this association of fungus and higher plant is beneficial or harmful to the latter, and under what circumstances, has been the subject of a major botanical controversy for 75 years. A joint study of this phenomenon by representatives of the Bureau of Plant Industry and the Forest Service was begun at the Station in 1930, and continued until 1938 in spite of the unavoidable withdrawal of substantial Forest Service participation in 1932. Begun in Sweden, the work was continued in the laboratories of the Boyce Thompson Institute and of the University of Pennsylvania. Although a fundamental study, requiring highly specialized knowledge of plant physiology and mastery of difficult laboratory techniques, this study held forth the possibility of practical applications of the greatest value. Notable progress was made in eight years in identifying the fungi responsible for mycorrhiza formation in the Allegheny territory; in clearing up, by publication, some common misconceptions of the nature of mycorrhiza; and in devising techniques which should eventually lead to satisfactory answers to the essential riddle: how, and to what extent, does the mycorrhizal fungus make available to the higher plant foods present in the soil but not assimilable through root hairs, or other so-called normal organs. These are no mean achievements in a field of great technical difficulty, and have contributed substantially to the standing of the Station among botanists. Much work begun at Philadelphia will come, or has already come, to fruition elsewhere.

Other worthwhile pathological investigations have evaluated the destructive Nectria cankers of hardwoods, common in the Kane Experimental Forest, and have identified the disease which in Philadelphia and other cities of the United States threatens to destroy one of our most valuable shade trees - the London plane.

FLOOD CONTROL SURVEYS

In the spring of 1936 floods in all the major streams of the northeastern United States, in addition to taking human life and causing incalculable human suffering, caused damage estimated at $500,000,000, half of it in Pennsylvania and Maryland. In the following year an even greater and more costly flood, originating in part in Allegheny territory, ravaged the Ohio Valley. The Flood Control Acts of 1936 and subsequent years authorized the Department of Agriculture to survey the watersheds of the principal streams of the Northeast, to ascertain whether condition of the watershed vegetation had contributed to the floods, and, where this was shown to be the case, to recommend measures to improve the watershed cover. These surveys were to be made in cooperation with the Army Engineers, who had long been charged with responsibility for downstream engineering works needed for flood control.

The Departmental machinery set up to conduct the Flood Control Surveys required the Forest Service, the Soil Conservation Service, and the Bureau of Agricultural Economics to work in closest cooperation. The Allegheny Station has represented the Forest Service in its territory, and for administrative reasons has been made largely responsible for the Surveys in New York and New England as well. Beginning in 1937 with a minute allotment, it expanded swiftly and with conspicuous success to meet a new and wholly unfamiliar task. During the past fiscal year, its expenditures for this work have equalled those for all other lines combined.

The degree of the Station's responsibility for the Surveys has varied from watershed to watershed, but within the Allegheny territory has been greatest with respect to the Passaic and Pequest Rivers. Although the work on both of these streams was classified as a "preliminary examination", it was fully as exacting, although not quite as detailed, as in the detailed surveys of other streams. The object of a preliminary examination is to determine whether there is a sufficient flood problem and sufficient prospects of abating the flood conditions by work on the watershed to justify more refined studies. Flood damage on the Passaic is periodically very great, but we lacked evidence to prove that changes in the present methods of handling watershed cover would materially reduce the flood damages. We therefore recommended no further work by the Department of Agriculture at the present time. A somewhat similar recommendation is about to be made for the Pequest River. Our report on a preliminary examination of the Lehigh River, on the other hand, recommended a detailed survey.

We have made major contributions, both scientific and administrative, to the detailed surveys of the Youghiogheny River and Codorus Creek, for which reports have been submitted to Washington, and of the Upper Allegheny and Susquehanna Rivers, work on which is still under way.

Our frank insistence that more facts, obtainable only through research, are required before we can submit satisfactory watershed reports for Northeastern streams has helped to shape future flood control survey work. A major effort is now being made to obtain at least preliminary evidence of the quantitative influence of vegetation on stream flow and erosion. We believe that we have also contributed substantially to the ultimate success of the flood control surveys by insisting on our full local cooperation with the Army Engineers, and by our willingness to make the best of administrative arrangements within the Department that have not always been ideal. In other words, we feel that we have vigorously aided to clear the decks for much more effective action than has been possible in the past. The information obtained on many technical aspects of the flood control surveys will be an invaluable background to the formal, long-term investigations of forest influences which we believe to be essential in our territory.

FOREST ECONOMICS

Although repeatedly sought by the Station since its establishment, funds for economic research did not become available until 1939. However, much economic information for the files was collected from time to time in the Station's territory. The most notable body of such information was in revision of the so-called Capper Report, so far as it covered the forest area and resources of the Allegheny territory. Information was compiled from a wide number of sources, and required much discrimination for its evaluation.

The allotment of Economics funds obtained in 1939 was for a survey of forest employment possibilities in the anthracite region of Pennsylvania. Comprehensive and far-reaching plans have been made for collecting data to show not only how much emergency labor may be fruitfully employed today in rehabilitating the region's depleted forests, but also the extent of the permanent forest industries which might be based on the restored resource.

With the cooperation of Region 7 of the Forest Service and the Pennsylvania Department of Forests and Waters, a report has been compiled from State records indicating the large number of physical improvements for fire protection which might be made in the region, and the specific improvements which we believe would be helpful in a selected area - the Wyoming Valley and vicinity - typical of the region. We have obtained much information on private forest land ownership in Luzerne County, and on forest land now in county possession in that and several other counties. The latter is available under Pennsylvania laws for conversion into community forests. We have made a promising start in an inventory of the forest resources of Luzerne County and their rate of growth. Successful use of WPA labor in the field work of the inventory is being worked out. A large amount of highly necessary map work has been completed, and progress made in the use of aerial photographs for the region.

THE BASIS FOR FUTURE ACCOMPLISHMENT

Forest research in the Middle Atlantic States is a business in which the Federal Government has invested impressive sums of money, and from which it has every right to expect a substantial return. As steward of these public funds, the Station has spent part of it in current research, the returns from which have been summarized above, and are detailed in our 130 publications. The balance we have invested in long-term research, the training of personnel, and physical facilities for our work.

Long-term research

This has yielded some current dividends in the form of published material, but is more in the nature of a capital investment. It consists of numerous permanent sample plots, mostly in our experimental forests; memoranda on techniques; progress reports; files of unpublished data and constantly improving plans for their analysis. Research, as its name implies, is cumulative. Isolated bits of information, inconsequential separately, gradually fall into a pattern of considerable significance. Knowledge of so complex a subject as the management of a forest type, or the economics of a forest region, increases both quantitatively and qualitatively in geometrical ratio as time passes. The Allegheny Station, after a little more than a decade of orientation and preparation, confidently expects to accelerate its production.

Personnel

Not all men joining the staff of the Allegheny Station have had adequate basic training for forest research, and even fewer have had significant experience in it. Nearly all have lacked intensive knowledge of local forest conditions. The aggregate experience in a variety of research, and the accumulated local knowledge, of three staff members who have spent 13 years at the Station, and of 4 who have spent from 3 to 5 years here, are among the Station's most valuable assets. In addition, the Station feels justified in calling attention to the accompanying list of former staff members, who left us to undertake work of responsibility elsewhere - work for which their training with us had in part fitted them.

S. R. Andrews, Bureau of Plant Industry, New Mexico; Arthur Bevan, Director, Tropical Forest Experiment Station; R. T. Clapp, Yale Forest School; A. A. Downs, Appalachian Forest Experiment Station; M. J. Harding, Pennsylvania Department of Forests and Waters; Dr. A. B. Hatch, Forest School, University of Idaho; Dr. H. J. Lutz, Yale Forest School; A. L. McComb, Forest School, Iowa State College; Dr. W. E. McQuilkin, Appalachian Forest Experiment Station; H. F. Morey, Northeastern Forest Experiment Station; Camman Niederhof, Rocky Mountain Forest Experiment Station; A. G. Randall, Region 2, Forest Service; E. M. Simmons, Region 1, Soil Conservation Service; and O. M. Wood, Central States Forest Experiment Station.

Physical facilities

Except at the Station's headquarters in Philadelphia, our physical plant for research far outruns our capacity to use it. It may be briefly described as follows:

Headquarters, Philadelphia. A greenhouse, 18 by 50 feet, adjacent to the MacFarlane Hall of Botany, University of Pennsylvania, directly connected to a basement laboratory, improved at the Station's expense.

Lebanon Branch Station, New Lisbon, N. J. A 525-acre forest, oak-pine type, for which a detailed soils map and a forest inventory have been made available. Improvements: Combined field laboratory-living quarters; bachelor's dwelling; 5-car garage; weather tower; commercial electric current. An intensive system of roads and firebreaks is maintained by the State Forest Service. In addition to this leased area, the Station controls for research purposes three other tracts aggregating 382 acres in south Jersey.

Kane Branch Station, Kane, Pa. An experimental forest of 1750 acres in the Allegheny hardwood-hemlock type. A wide variety of age classes and conditions, typical of the Allegheny National Forest and the Allegheny Plateau. Detailed soils map and forest inventory completed. Improvements: Three small dwellings, one suitable for winter occupancy; combined field laboratory and bunk house; garage, tool shop, etc.; weather and water towers; commercial electric current. A fairly intensive road system and satisfactory firebreaks on all exposed boundaries; Region 7 of the Forest Service shares in the upkeep of roads.

Other research areas include the Tionesta Natural Area, Allegheny National Forest, of some 4100 acres, in the purchase of which the Station took active leadership, and the Hearts Content Natural Area of 125 acres (portions of both areas are accessible to public use of a restricted character); and semi-permanent plots in the Allegheny National Forest aggregating 30 acres.

Standing Stone Branch Station, Manor Hill, Pa. A 2300-acre experimental forest in the oak type. Improvements: A roomy bunk house; a small dwelling for year-long use; a garage; a large equipment shed; a weather tower; commercial electric current. The forest is typical in species, site, and age (although somewhat lacking in the older age classes) of the farm woodlands of central Pennsylvania. It has a fairly good road system.

Eastern Shore Experimental Forest, Parsonsburg, Md. A 1000-acre experimental forest, chiefly of loblolly pine. Improvements: A field laboratory; two dwellings, one suitable for year-long use; a garage-workshop; a satisfactory road system.

Research Center (Beltsville), Laurel, Md. An 1800-acre experimental forest of oak-pine, principally Virginia pine and upland oaks. Improvements: A laboratory; a bunk house; two dwellings for year-long use; a garage; a temporary dwelling; commercial electrical current; a fair system of roads and firebreaks. Improvements are maintained, at cost, by the Beltsville Research Center, of the Department.

Regional goodwill

The Allegheny Station may reasonably list among its present assets regional goodwill. To have accumulated valuable facts, or to have put ourselves in a position to do so, is a quite useless accomplishment, unless we have also created among those whom we seek to serve a willingness to accept the results of our research, and to apply it to the territory's 22,000,000 acres of forest. In the face of certain very definite handicaps, which the Council might help us to overcome, the Station feels that it has won considerable respect for its findings, and has created a genuine desire for more information. Our belief is based on such instances as the following of cooperation which exists between the Station and the numerous organizations of its territory which are in one way or another concerned with forests.

For several years the Eastern Region (Region 7) of the Forest Service has financed on CCC funds our investigation of planting in northwestern Pennsylvania, and more recently of growth of farm woodlands on the Eastern Shore of Maryland. The Region has this year asked us to help it in a study of timber sale practices in the Allegheny National Forest.

Over a period of two years, the New Jersey Forest Service contributed $2,000 to our studies of fire. It has assigned to our use some of the best timber in its South Jersey State Forests, and has constantly sought our advice in improving its fire protection and in the silvicultural management of its South Jersey forests.

In response to a specific request from the Maryland authorities, we have conducted investigations in white pine plantations, and in natural stands of Virginia pine, which are the basis for CCC operations on public lands. Our advice has been sought in formulating forest management plans for newly-acquired State forests in western Maryland.

At the urgent request of the nurserymen in charge, we have prescribed soil treatments against disease and other conditions for nearly every State nursery in our territory. A large pulp and paper company in northwestern Pennsylvania has requested and received our technical advice in several emergencies.

Members of the Station's staff have been continuously prominent in the affairs of the Allegheny Section of the Society of American Foresters. One member was Chairman of the Section in 1931; another was

Secretary for several years, and others have served as chairmen or members of a large number of active and important committees. The Station has been active on drainage basin committees of the National Resources Planning Board for the major streams of its territory, and on a committee of the Interstate Commission on the Delaware River Basin. It has been influential in the Pennsylvania Forestry Association.

The Station has in its turn commanded the cooperation of the New Jersey and Pennsylvania Agricultural Experiment Stations in soil analyses and soil maps for our experimental areas, and in a wide variety of ways have cooperated with such educational institutions as the University of Pennsylvania, the University of Pittsburgh, Yale, Cornell, and Syracuse.

PLANS FOR THE FUTURE

The Station is now engaged in studying the future forest research needs of its territory. It hopes to present a program to the Advisory Council at its next meeting. A preliminary consideration reveals unanswered questions varying from such purely biologic problems as how to restore Atlantic white cedar to swamps now dominated by low value hardwoods, to such involved economic and political science questions as how to integrate forest production with permanent industrial needs, community stability, and national economic welfare. Studies that have been already completed or begun provide us with a background upon which plans for the future can be soundly projected.

ALLOTMENTS TO THE ALLEGHENY STATION BY YEARS

Allotments by Lines of Work

Fiscal Year	Forest Management	Forest Economics	Flood Control	Total
1928	$29,400			$29,400
1929	30,000			30,000
1930	31,220			31,220
1931	31,220			31,220
1932	31,500			31,500
1933	30,770			30,770
1934	27,461			27,461
1935	21,263			21,263
1936	23,350			23,350
1937	29,200			29,200
1938	29,200		$10,000	39,200
1939	29,200		25,400	54,600
1940	39,394 *	$16,200	38,950	94,544
1941	34,200 **	15,200	94,959 #	144,359

* Includes $11,000 for fundamental research of nation-wide importance at the Agricultural Research Center, Beltsville, Maryland.

** Includes $7,500 for research at the Agricultural Research Center, Beltsville.

Includes $83,000 for surveying streams outside the Allegheny Station's territory.

United States Department of Agriculture

ALLEGHENY FOREST EXPERIMENT STATION

ANNOTATED LIST OF PUBLICATIONS
1928-1939 (inclusive)

****

Station No.

General and Miscellaneous

2* Forbes, R. D. 1930 — What Uncle Sam does to solve the forest problem. Engineers and Engineering 47#4, 89-92. (A popular account of how the U. S. Forest Service organizes its research)

3 Forbes, R. D. 1930 — Progress in the research reserve program. Jour. Forestry 28#4, 574-575. (Describes the Heart's Content virgin (white pine) timber purchase)

4 Forbes, R. D. 1930 — Review "Forestry and coal mining" by Clearfield Bituminous Coal Corporation. Jour. Forestry 28#5, 749-750.

5 Forbes, R. D. 1930 — The National Forest Reservation Commission and forest research reserves. Science 71#1846, 505. (Emphasizes precedent established by Heart's Content purchase)

6* Forbes, R. D. 1930 — The Federal forest experiment stations. New York Times. December 1930.

9 Lutz, H. J. 1930 — Review of "The forestry question in Great Britain" by E. P. Stebbing. Jour. Forestry 28#1, 78-80.

14* Morey, H. F. 1931 — Climatological charts for the Allegheny forest region. Mo. Weather Review 59#1, 18-28, figs. (Charts cover precipitation, annual and seasonal temperatures, and length of growing season)

27 Hough, A. F. 1933 — Virgin forest in Pennsylvania yields research results. Forest Worker, March 1933, p. 11. (Presents information obtained from Tionesta virgin forest; hemlock-hardwoods in Pennsylvania)

31* Wood, O. M. 1933 — Litter cover and soil surface temperatures, oak-pine type. Mimeographed. Tech. Note #3.

---

* Copies available for distribution. Orders may be placed by Station number.

Station No.		
40	Forbes, R. D. 1934	The thousandth acre. Am. Forests 40#2, 51-54. (An illustrated account of Tionesta virgin area and reasons for its preservation)
50	Forbes, R. D. 1935	Tionesta forest. New York Times, Sunday edition, January 6, 1935.
51	Forbes, R. D. 1935	Forest area annually cut over. Mimeographed. Tech. Note #8.
69*	Hough, A. F. 1936	Estimated area of forest land in three major forest regions of the Allegheny Forest Experiment Station territory. Mimeographed. Tech. Note #11.
76	Downs, A. A. 1937	Glaze storm of March 17-19, 1936, in Pennsylvania and New York. Mo. Weather Review 65#3, 100-101, illus. (A meteorological description; effect of glaze on the forest described in #93)
77	Forbes, R. D. 1937	Deep in the woods. Forest Leaves 27#1, 1-2. (A popular description of silvicultural research)
78	Forbes, R. D. 1937	The Jersey Pines. Am. Forests 43#11, 521-3, 561, illus. (Emphasizes possibilities of southern New Jersey as recreation ground for New York and Philadelphia)
79	Hoffmann, J. S. 1937	Building sanitary springs. Service Letter, Pa. Dept. of Forests and Waters, Series 8#33, October, 1937.
95	Forbes, R. D. 1938	"In cooperation with the University of Pennsylvania." The General Magazine and Historical Chronicle, April, 1938. Vol. 40#3. Published by the General Alumni Society, University of Pennsylvania. (An account of the Allegheny Station's work and its place on the campus)
101*	Mollenhauer, Wm., Jr. 1938	Spring structures. Mimeographed. Misc. Note #1.
106	Schnur, G. L. 1938	Will we cooperate? Editorial. Forest Leaves 28#3, 4.
112	Harding, M. J. 1939	Let's look at the Pennsylvania State Game Commission. Forest Leaves 29#1, 5, 15.

Station No.		
121*	Staff, Allegheny Forest Experiment Station 1939	The Kane Experimental Forest of the Allegheny Forest Experiment Station. Processed. July 1939. 13 pp. illus. maps. (A popular guide to research current in this tract of northern hardwoods-hemlock)

Silviculture

1	Berg, Birger 1929	An improved method for numbering trees on permanent sample plots. Jour. Forestry 27#6, 750.
8	Lutz, H. J. 1930	The vegetation of Heart's Content, a virgin forest in northwestern Pennsylvania. Ecology 11#1, 1-29, illus. (Detailed botanical account of virgin forest dominated by white pine)
11*	Wood, O. M. 1930	Windfirmness of hemlock left after logging. Mimeographed. Tech. Note #2.
15	Morey, H. F. 1931	Tags and painted numbers on trees in permanent sample plots. Jour. Forestry 29#5, 821-2.
17*	Hough, A. F. 1932	Some diameter distributions in forest stands of northwestern Pennsylvania. Jour. Forestry 30#8, 933-43, figs. (Presents proof that white pine maintained itself in virgin forest as a result of natural catastrophes)
18	Schnur, G. L. 1932	Mortality in old field loblolly pine. Forest Worker, May 1932, p. 7.
20	Wood, O. M. 1932	An example of white pine reproduction on burned lands in northeastern Pennsylvania. Jour. Forestry 30#7, 838-845.
22	Forbes, R. D. 1933	How to stop forest devastation. Contribution to a national plan for American forestry. Sen. Doc. #12, 73d Congress, 1st Session. (A Nation-wide discussion of the extent of forest devastation and remedies for it)
32	Wood, O. M. 1933	Acorns from the same tree tend to be uniform. Forest Worker, July 1933, p. 11.
44	Wood, O. M. 1934	A brief record of seed productivity for chestnut oak in southern New Jersey. Jour. Forestry 32#9, 1014-16.

Station No.		
45*	Wood, O. M. 1934	The root system of a chestnut oak (Quercus montana Willd.) Proc. Tenth National Shade Tree Conference. p. 95-98. (Results of hydraulic excavation of entire root system of a sapling; root vs. crown spread, etc.)
49	Forbes, R. D. 1935	Review of "Ecological relations in the pitch pine plains of southern New Jersey" by H. J. Lutz, Yale School of Forestry Bulletin #38. Yale Forest School News, January 1935. (Prof. Lutz' conclusive study followed his preliminary studies, for the Station, of South Jersey ecology)
53*	Hough, A. F. 1935	Crown cover and open space before and after partial cutting on permanent sample plots. Mimeographed. Tech. Note #5.
55*	Hough, A. F. 1935	Crown spread of Allegheny hardwoods. Mimeographed. Tech. Note #7.
61	McQuilkin, W. E. 1935	Root development of pitch pine, with some comparative observations on shortleaf pine. Jour. Agr. Research 51#11, 983-1016, illus. (A workmanlike study of pine root systems, from seedlings to mature trees)
62	Simmons, E. M. 1935	Pruning and thinning a white pine plantation in the southern Appalachians. Jour. Forestry 33#5, 519-522.
66	Hough, A. F. 1936	A climax forest community on East Tionesta Creek in northwestern Pennsylvania. Ecology 17#1, 9-28, illus. (Comparable to #8, but describes a remnant of the northern hardwood-hemlock type)
67*	Hough, A. F. 1936	The dying of hemlock and other species on the Allegheny National Forest. Mimeographed. Tech. Note #9.
68*	Hough, A. F. 1936	Epicormic branching of Allegheny hardwoods. Mimeographed. Tech. Note #10.
71*	McIntyre, A. C. and Schnur, G. L. 1936	Effects of drought on oak forests. Pa. State School of Agr. and Exp. Sta. Bull. 325, 43 pp. (A cooperative study of some effects of the Nation-wide drought of 1930 on the forests of central Pennsylvania)

Station No.		
72	Morey, H. F. 1936	A comparison of two virgin forests in northwestern Pennsylvania. Ecology 17#1, 43-55, illus. (Compares the forests described in #8 and #66)
80*	Hough, A. F. 1937	A study of natural tree reproduction in the beech-birch-maple-hemlock type. Jour. Forestry 35#4, 376-378.
81*	Hough, A. F. 1937	Why timber stand improvement? Jour. Forestry 35#9, 813-822. (Timed in connection with CCC "TSI" activities)
86*	Ostrom, C. E.	Tree form and defects in young beech-birch-maple-hemlock stands. Mimeographed. Tech. Note #14.
90*	Simmons, E. M. and Schnur, G. L. 1937	Effect of stand density on mortality and growth of loblolly pine. Jour. Agr. Research 54#1, 47-58. (Outlines principles which underlie thinning out and other cultural measures)
91*	Wood, O. M. 1937	The fall of shortleaf pine seed in southern New Jersey. Mimeographed. Tech. Note #18.
96*	Hough, A. F. 1938	Recommended timber stand improvement practices in northern hardwoods-hemlock on the Allegheny Plateau. Mimeographed. Occ. Paper #1. (Summarizes and applies information obtained in Station's extensive studies in this type)
100	Little, Silas, Jr. 1938	Relationships between vigor of resprouting and intensity of cutting in coppice stands. Jour. Forestry 36#12, 1216-1223.
102*	Mollenhauer, Wm., Jr. 1938	Tools and methods in an experimental pruning of white pine. Jour. Forestry 36#6, 588-599, illus. (A good example of practical studies conducted for the CCC)
103	Ostrom, C. E. 1938	Clear cutting of young northern hardwoods stands. Jour. Forestry 36#1, 44-49. (Shows why satisfactory reproduction obtained by clear cutting virgin forests cannot be expected in second growth)

Station No.		
105	Ostrom, C. E. 1938	Servant fires. Am. Forests 44#3, 118-9. (A popular account of burned safety-strips in southern New Jersey)
109*	Wood, O. M. 1938	Seedling reproduction of oak in southern New Jersey. Ecology 19#2, 276-293 (Summarizes factors preventing satisfactory seedling reproduction)
110*	Wood, O. M. 1938	Seed dispersal of southern white cedar. Mimeographed. Tech. Note #21.
111	Forbes, R. D. 1939	Review of "Sagas of Evergreen" by Frank H. Lamb. Jour. Forestry 37#11, 908-9.
117*	Mollenhauer, Wm., Jr. 1939	Table mountain pine - squirrel food or timber tree? Jour. Forestry 37#5, 420-1.
118	Ostrom, C. E. 1939	Review of "La question des exotiques" by A. Engel. Jour. Forest. Suisse; "Essences exotiques dans la foret francaise" by L. Parde. Bull. Soc. Forest. Franche-Comte; "Le robinier en Roumanie" by J. Venet. Rev. Eaux et Forets. Jour. Forestry 37#12, 985-6.
123*	Wood, O. M. 1939	Persistence of stems per sprout clump in oak coppice stands of southern New Jersey. Jour. Forestry 37#3, 269-70.
124*	Wood, O. M. 1939	Relation of the root system of a sprouting stump in Quercus montana Willd. to that of an undisturbed tree. Jour. Forestry 37#4, 309-12. (A unique investigation of the very common but little-understood phenomenon of sprouting)
125*	Wood, O. M. 1939	The use of "Gooseneck" and Six's thermometers for measuring soil temperature. Jour. Forestry 37#5, 421-3.
126*	Wood, O. M. 1939	Reproduction of shortleaf pine following mechanical treatment of the seedbed. Jour. Forestry 37#10, 813-4.
128*	McClennen, F. H., Jr. 1939	Further notes on seed productivity of chestnut oak in southern New Jersey. Mimeographed. Tech. Note #24.

Station No.

Mensuration

7*	Hough, A. F. 1930	Stump diameter - d. b. h. relationship for beech in northwestern Pennsylvania. Mimeographed. Tech. Note #1.
13*	Morey, H. F. 1931	A test of hypsometers on short trees. Jour. Forestry 29#2, 233-237. (Compares several methods of measuring tree heights)
16*	Schnur, G. L. and McIntyre, A. C. 1931	The measurement of mine props, linear foot, top diameter, weight and volume tables. Pa. School of Agr. and Exp. Sta. Bull. 269; 24 pp., illus. (Presents tables showing volume of trees of different dimensions in terms of mine timbers. A cooperative study with Pennsylvania State College)
19	Schnur, G. L. 1932	Converting factors for some stacked cords. Jour. Forestry 30#7, 814-820, figs.
42*	Schnur, G. L. 1934	Diameter distributions for old-field loblolly pine stands in Maryland. Jour. Agr. Research 49#8, 731-743. (Presents unique information, obtained from long-term studies, basic to thinnings and other cultural operations)
43	Schnur, G. L. 1934	Review of "Perfecting a stand-density index for even-aged forests" by L. H. Reinecke in Jour. Agr. Research, April 1933. Jour. Forestry 32#3, 355-356.
54*	Hough, A. F. 1935	Relative height growth of Alleghany hardwoods. Tech. Note #6. Mimeographed.
56	Hough, A. F. 1935	A method of preparing wood sections for accurate age counts. Jour. Forestry 33#7, 698. (Based on extensive experience with a difficult technique)
70*	Hough, A. F. 1936	Height growth of hemlock and hardwood seedlings in a virgin stand on East Tionesta Creek. Mimeographed. Tech. Note #12.
73*	Morey, H. F. 1936	Age-size relationship of Heart's Content, a virgin forest in northwestern Pennsylvania. Ecology 17#2, 251-257. (Further information on the virgin white pine described in #8)

Station No.		
84*	Meyer, E. F. 1937	Volume tables for plantation-grown white pine (Pinus strobus L.). Mimeographed. Tech. Note #16.
85*	Meyer, E. F. 1937	Volume tables for plantation-grown yellow poplar (Liriodendron tulipifera L.). Mimeographed. Tech. Note #17.
89*	Schnur, G. L. 1937	Yield, stand, and volume tables for even-aged upland oak forests. U. S. Dept. Agr. Tech. Bull. #560, 87 pp. (A comprehensive treatise on the growth rates of the upland oaks of the entire eastern United States. Includes tables of tree volume in cubic and board feet; of stand volume at different ages, in the same units; and of tree diameter distribution in stands of different ages. Discusses application of data to understocked stands)
104*	Ostrom, C. E. and Taylor, L. E. 1938	Relation of stump diameter to breast-height diameter of northern hardwoods. Mimeographed. Tech. Note #23.
113	Hotzel, J. E. 1939	An extension rod for measuring tree heights. Jour. Forestry 37#6, 494-5.
115	Mesavage, Clement 1939	Comments on Henze's article, "A device for measuring sample plot radius", and subsequent discussion by G. H. Lentz and Ellwood Wilson. Jour. Forestry 37#12, 972-4.
122	Turberville, H. W. and Hough, A. F. 1939	Errors in age counts of suppressed trees. Jour. Forestry 37#5, 417-8. (Reveals the possibility of serious underestimates of tree age)
129*	Schnur, G. L. 1939	Volume tables for loblolly pine (Pinus taeda L.). Mimeographed. Tech. Note #25.
		Regeneration
52*	Hazen, J. F. and Wood, O. M. 1935	Animal damage in relation to size of planting stock. Mimeographed. Tech. Note #4.

Station No.		
74*	Wood, O. M. 1936	Early survival of some pine interplantings in southern New Jersey. Jour. Forestry 34#9, 873-878. (Preliminary information on a practice extensively followed by the New Jersey Forest Service)
127	Hetzel, J. E. 1939	A guidance leaflet for CCC planting in northwestern Pennsylvania. March 1939. 13 pp. Mimeographed. (A practical application of the results of research to an important problem)
		Protection
10	Lutz, H. J. 1930	Effect of cattle grazing on the vegetation of a virgin forest in northwestern Pennsylvania. Jour. Agr. Research 41#7, 561-570, illus.
41	Hough, A. F. 1934	Natural enemies of the forest. Forest Leaves 24#1, 3-6, illus. (A popular account)
75*	Wood, O. M. 1936	First-year losses after a fire may not represent total mortality. Mimeographed. Tech. Note #13.
83*	Little, Silas, Jr. 1937	Deer damage to pine reproduction in southern New Jersey. Mimeographed. Tech. Note #19.
87*	Ostrom, C. E. 1937	Deer and rabbit injury to northern hardwood reproduction. Mimeographed. Tech. Note #15.
88	Ostrom, C. E. 1937	Where do deer and rabbits feed? Pa. Game News 8#8, 15, 30.
93	Downs, A. A. 1938	Glaze damage in the birch-beech-maple-hemlock type of Pennsylvania and New York. Jour. Forestry 36#1, 63-70. (Contains information on relative resistance of common species to a destructive agency very important in long-term management)
99	Jackson, L. W. R. 1938	Winter injury of Buxus sempervirens. Phytopathology 28:372-374.
114*	Mesavage, Clement 1939	Frost damage to forests in northern New Jersey. Jour. Forestry 37#4, 345-6.

Station No.		
120	Schnur, G. L. 1939	Heat drying to trees often slow to appear. Forest Leaves 29#1, 11.

Influences

12*	Forbes, R. D. 1931	Watershed cover and water conservation. Proc. Maryland and Delaware Water and Sewerage Association. May 1931. (More or less popular summaries of available information on forest influences)
21	Forbes, R. D.; Schnur, G. L.; et al 1933	Watershed and related forest influences. Contribution to a national plan for American forestry. Sen. Doc. No. 12, 73d Congress, 1st Session. (A compilation of all data then available on a little-explored subject)
39*	Forbes, R. D. 1934	Ruling the river. Sci. Monthly 38:524-533. June 1934., illus. (More or less popular summaries of available information on forest influences)
63*	Wood, O. M. 1935	Forest removal affects local climate and growing conditions. U. S. Dept. Agr. Yearbook, 1935. p. 206-208. (Suggestive data on micro-climate as affected by South Jersey forests)
65	Forbes, R. D. 1936	Forests and flood control. Forest Leaves 26#4, 19-20. (More or less popular summaries of available information on forest influences)
92*	Wood, O. M. 1937	The interception of precipitation in an oak-pine forest. Ecology 18#2, 251-254. (Suggestive data on micro-climate as affected by South Jersey forests)

Pathology and Mycorrhizae

23	Hartley, Carl and Jackson, L. W. R. 1933	A brooming disease of Robinia pseudoacacia transmitted by grafts. Phytopathology 23:13 (abs.)
24	Hatch, A. B. 1933	Pure culture technique for quantitative studies of plant growth in association with micro-organisms. Phytopathology 23:14 (abs.)

Station No.		
25	Hatch, A. B. 1933	True mycorrhizal fungus in contrast to Mycelium radicis atrovirens. Phytopathology 23:14 (abs.)
26	Hatch, A. B. and Doak, K. D. 1933	Mycorrhizal and other features of the root systems of Pinus. Jour. Arnold Arboretum 14:85-98, illus. (Clears up some common misconceptions of the nature of mycorrhizae)
28	Jackson, L. W. R. and Hartley, Carl 1933	Transmissibility of the brooming disease of black locust. Phytopathology 23:83-90.
29	Jackson, L. W. R. 1933	Effect of sulphuric acid and aluminum sulphate, as used for the control of damping-off of conifers, on soil pH. Phytopathology 23:18 (abs.)
30	Jackson, L. W. R. 1933	Effects of H-ion and aluminum-ion concentrations on conifer damping-off. Phytopathology 23:18 (abs.)
33	Doak, K. D. 1934	Mycorrhizae and their relation to shade trees. Proc. National Shade Tree Conference. 10: 99-105.
34	Doak, K. D. 1934	Cortical parasitism of conifer-seedling roots in pure culture by mycorrhizal and non-mycorrhizal fungi. Phytopathology 24:6-7.
35	Doak, K. D. 1934	Fungi that produce ectotrophic mycorrhizae of conifers. Phytopathology 24(1):7 (abs.)
36	Doak, K. D. 1934	Directions for surface sterilization of mycorrhizal roots with chloramine. Mimeographed. 2 pp., illus.
37	Doak, K. D. 1934	Relation of mycorrhizae and pseudomycorrhizae to conifer seedling chlorosis. Mimeographed. 5 pp. (tables).
38	Doak, K. D. and Hatch, A. B. 1934	A critical review of "The relation of mycorrhizae to conifer seedlings" by R. E. McArdle in Jour. Agr. Research 44#4, 287-316. Mimeographed. 12 pp.

Station No.		
46	Andrews, S. R. 1935	The incidence of Nectria canker in the sugar maple-beech-yellow birch type near Kane, Pennsylvania. Thesis, Yale School of Forestry. In Yale library.
47	Doak, K. D. 1935	Suggestions for analysis of mycorrhizal conditions of coniferous nursery stock. Mimeographed. 4 pp.
48	Doak, K. D. and Cohen, Isadore 1935	The fixing and staining of Liriodendron tulipifera root tips and their mycorrhizal fungus. Stain Technology 10:25-32.
57	Jackson, L. W. R. and Crandall, B. S. 1935	A Phytophthora root and collar rot of Pinus resinosa seedlings. Phytopathology 25:22 (abs.)
58	Jackson, L. W. R. and Sleeth, Bailey 1935	A new disease affecting Platanus orientalis in the eastern United States. Phytopathology 25:22 (abs.) (The first published accounts of an alarming disease now destroying the London plane, a shade tree widely used in the eastern United States)
59*	Jackson, L. W. R. 1935	A new disease of the Oriental plane tree (Platanus orientalis L.) prevalent in the Philadelphia area. Proc. Eleventh Nat. Shade Tree Conference. pp. 77-79. (The first published accounts of an alarming disease now destroying the London plane, a shade tree widely used in the eastern United States)
60	Lisi, A. F. and Doak, K. D. 1935	An abnormal Amanita muscaria. Proc. Pa. Academy Sciences. 9:86.
64	Doak, K. D. 1936	Mycorrhizae of trees and shrubs. Bull. Morris Arboretum 1(4):45-49, illus.
82*	Jackson, L. W. R. and Sleeth, Bailey 1937	Disease killing the plan trees. Forest Leaves 27#2, 5-6, 14-15, illus.
94	Forbes, R. D. 1938	"Mikes" - A Botanical Enigma. Sci. Monthly, 46:32-40. January 1938. (A popular account of mycorrhizae)

Station No.		
97	Jackson, L. W. R. 1938	Cylindrocladium associated with diseases of tree seedlings. The Plant Disease Reporter 22#5, 84-85.
98	Jackson, L. W. R. and Kaplan, F. 1938	Dodder damages black locust seedlings at a Pennsylvania nursery. Jour. Forestry 36#7, 712.
107*	Sleeth, Bailey 1938	Decay in black cherry damaged by glaze. Mimeographed. Tech. Note #20.
108*	Sleeth, Bailey 1938	Pruning wounds as an avenue of entrance for Stereum Sanguinolentum in northern white pine plantations. Mimeographed. Tech. Note #22.
119*	Roth, Elmer P. and Sleeth, Bailey 1939	Butt rot in unburned sprout oak stands. U. S. Dept. Agr. Tech. Bull. #684, 42 pp. (Bureau of Plant Industry in cooperation with Allegheny Forest Experiment Station.) (An extremely practical treatise on an important source of defect in Eastern hardwoods, in relation to cultural operations in sprout stands)
		Economics
116	Mesavage, Clement 1939	Forestry and the future of the Anthracite Region. Forest Leaves 29#2, 3, 13. (A popular account of the role which forestry might play in alleviating menacing economic conditions in a populous region)